

A NEW DEEP-SEA SPECIES OF THE GENUS *NEOLEPTON* (BIVALVIA; CYAMIOIDEA; NEOLEPTONIDAE) FROM THE ARGENTINE BASIN

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ABSTRACT

A new species of *Neolepton* is described from mid to lower slope depths of the Argentine Basin. This, the first deep-water species of the Neoleptonidae to be described, differs little from the shallow-water species of the genus. It has features in common with species of the family Kelliellidae, but it is concluded that these reflect convergence due to similar life styles, rather than a particularly close relationship. *Neolepton* also has features in common with the venerid bivalves, and as has been suggested by other authors, it is possible that this is an example of paedomorphism.

Key Words: Bivalvia, Neoleptonidae, deep-sea

INTRODUCTION

In studies of the deep-sea bivalves of the Atlantic, a small, white, ovate species, with a heart-shaped, lunule, was provisionally placed in the family Kelliellidae (Allen, in ms). When specimens were opened and the hinge and internal morphology examined, it was found that the species belonged to the Neoleptonidae and as such is the first recorded deep-sea species of the family.

This new species was taken from the Argentine Basin as part of studies of the abyssal fauna of the Atlantic led by Dr. Howard Sanders of the Woods Hole Oceanographic Institution. It was taken with an epibenthic sledge, preserved first in 4% formal saline, and then transferred to 95% ethanol. The internal morphology was studied using whole mounts lightly stained in Erlich's haematoxylin.

SYSTEMATICS

Although *Neolepton sulcatulum* (Jeffreys, 1859), type species (Crosse, 1885) of the genus *Neolepton* Monterosato, 1875 (type genus of the family Neoleptonidae Thiele, 1935), is European, most of the described species of *Neolepton* are found south of the equator (Soot-Ryen, 1960; Ponder, 1969; Boss, 1982; Salas & Gofas, 1998), although

Salas & Gofas (1998) concluded that *Halodraka* from the eastern Pacific and north of the equator that had been placed in the Bernardinidae (Coan, 1984) is synonymous with *Neolepton*. Until now the described species have all been found in the intertidal or shelf seas.

The species described here has two posterior mantle apertures, and prior to the work of Salas & Gofas (1998) this fact would have placed it in the genus *Notolepton* Finlay, 1927 (Ponder 1969). Salas & Gofas (1998) showed that *Neolepton sulcatulum*, which, before their elegant research, had been thought to have only one posterior mantle aperture, has two, and thus they synonymized the two genera.

Genus *Neolepton* Monterosato, 1875

Type species: *Lepton sulcatulum* Jeffreys, 1859, subsequent designation by Crosse (1885).

For further details of the taxonomy and diagnosis of the genus, see Ponder (1969) and Salas & Gofas (1998).

***Neolepton profundorum*, new species.**

Type Locality: Argentine Basin, 36°53.4'S, 53°10.2'W, 2,323 m.

Type Material: Holotype, The Natural History Museum, London, 1998186; 3 paratypes,

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Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, 318093.

*Material:* Atlantis II, sta.237, 36°32.6'S, 53°23.0'W, 1,011 m, 173 spec.; sta. 240, 36°53.4'S, 53°10.2'W, 2,323 m, 8 spec.

Although station 237 yielded many more specimens, they had been much eroded through poor preservation and thus station 240 with the smaller number of specimens, but in good condition, was chosen for type material and type locality.

*Distribution:* Found at lower slope depths in the Argentine Basin. Depth range: 1,011–2,323 m.

*Shell Description* (Figs. 1–3): The shell is very small (largest specimen 2.5 mm total length), somewhat elongate, becoming more so with increasing size (length/height ratio 0.81–0.75; length/width ratio 0.49–0.50); it is semitranslucent, white, with very fine, faint, irregular concentric lines and very faint discontinuous radial plicae. The umbo is not very prominent and is directed slightly anterior and intumed. The lunule is elongate, lozenge-shaped, and the margin is well defined by a fine line. There is no escutcheon. The antero-ventral and ventral shell margins are smoothly curved, the postero-ventral and posterior margins are broadly concave, and the postero-dorsal margin is straight, angled downwards to meet posterior margin posterior to adductor in a rounded angle. The antero-dorsal lunular margin is more or less straight. The ligament has internal and external components; the external, which is formed from fusion layer, is elongate, the posterior part being twice as long as the anterior. It is attached to dorsal edge of hinge plate with little visible externally. The internal ligament (resilium) forms an arched wedge ventral to umbo that extends to the ventral edge of hinge plate. It is formed by inner and outer layers with no obvious mineralization. The hinge plate is moderately broad. In the right valve, cardinal (1a) forms a broad triangular shelf at the ventral edge of the plate anterior to umbo. A slender ridge (3a) dorsal and parallel to cardinal 1a lies close to the dorsal margin of plate. In larger specimens, this ridge may end anteriorly as an incurved scroll. Immediately anterior to the resilium, a small cardinal (3b) extends vertically across hinge plate. Posterior to the resilium, a slender posterior lateral tooth (PI) forms a diagonal ridge posterior to resilifer.

## List of Abbreviations in Figures

AA	anterior adductor muscle
AL	anterior outer ligament (fusion layer)
AN	anus
AR	anterior pedal retractor
CG	cerebral ganglion
DG	digestive diverticula
DL	dorsal lip
DP	dorsal palp
EA	exhalant aperture
EG	epithelial glands
ES	exhalant siphon
FM	first gill filament
FT	foot
GA	gill axis
GE	attachment of ascending lamella of inner demibranch
HG	hindgut
IA	inhalant aperture
ID	inner demibranch
IL	inner layer
KD	kidney
LV	left valve
MO	mouth
OD	outer demibranch
OE	oesophagus
OL	outer layer
OG	proximal oral groove
OV	ovary
PA	posterior adductor muscle
PG	pedal ganglion
PL	posterior outer ligament (fusion layer)
PR	posterior pedal retractor muscle
RS	resilium
RV	right valve
ST	stomach
VG	visceral ganglion
VP	ventral palp
VT	ventricle
1a	right anterior cardinal
2a	second left anterior cardinal
2b	first left anterior cardinal
3a	first right anterior cardinal
3b	second right anterior cardinal
4b	possible rudimentary left posterior cardinal
PI	right anterior lateral
PII	left posterior lateral

The hinge plate merges with antero-dorsal and postero-dorsal shell margins. The left hinge plate has inverted spoon-shaped anterior cardinals (2a and 2b), which interlock dorsally with cardinal (1a). Anterior to cardinal (2a) and ventral to the lunule, the plate is relatively broad and ventrally raised. In some specimens, immediately posterior to the resilifer, there is a small incipient ridge aligned with posterior edge of the resilifer and possibly equivalent to cardinal (4b). A broad, elongate posterior lateral tooth (PII) lies close to and slightly oblique to the dorsal margin. The prodissoconch (length 364  $\mu\text{m}$ ) is almost circular, with a well-marked peripheral rim.

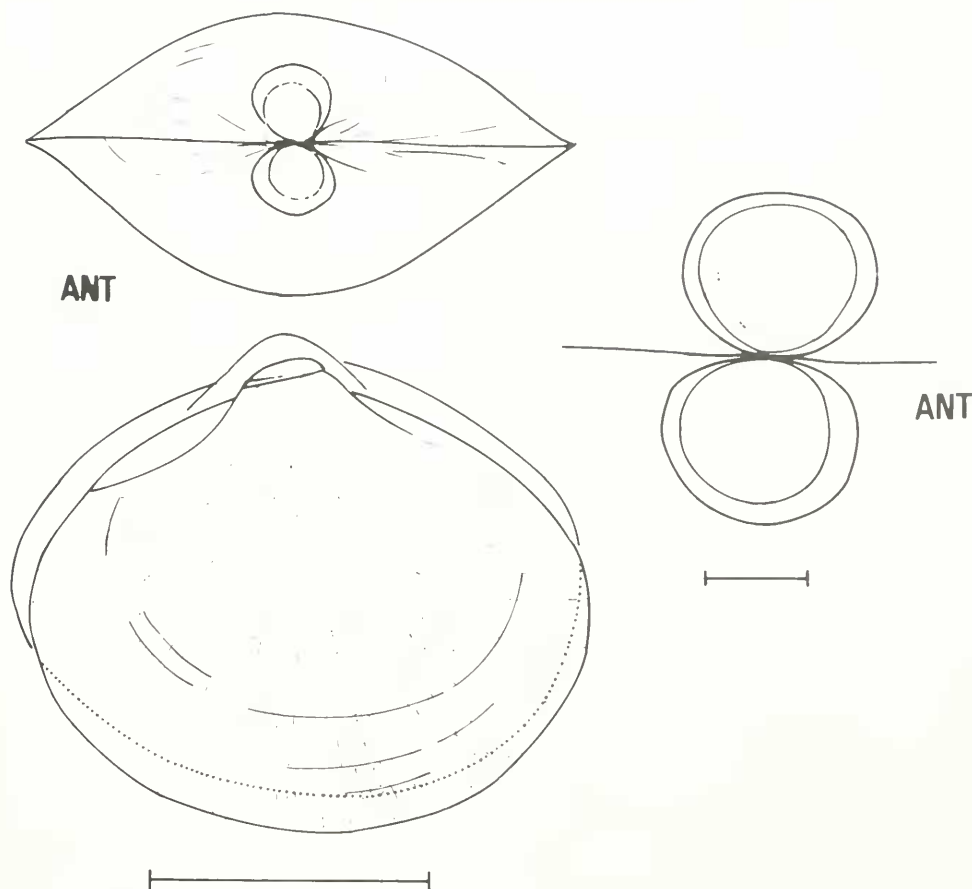


FIG. 1. Dorsal and left lateral views of paratype specimens from the type locality showing variation in shell outline (scale = 1.0 mm), and an enlarged dorsal view of a prodissoconch showing the neoleptonid outer rim (scale = 0.2 mm).

There is some variation in the outline of the shell (Fig. 1) and more particularly in the hinge plates. In the latter (Fig. 2), there is variation in the size and shape of the cardinal teeth, although the basic form remains the same. The fine raised posterior edge of the resilifer of the left hinge plate present in some specimens, may be homologous with the cardinal 4b of veneraceans (see Discussion).

*Internal Morphology* (Figs. 4–6): The mantle edge is very broad and particularly so in the region of the posterior mantle apertures. As in other neoleptonids (Salas & Gofas, 1998), it has four folds, the additional fourth fold being formed as a subdivision of the middle sensory fold. Internal to the inner fold, extending from

the ventral margin of the anterior adductor muscle to the junction of the gill axis with the mantle, there is a broad band of radial pallial muscles overlain by a very glandular inner mantle epithelium. The latter extends from the anterior adductor to the posterior limit of the pedal gape. The gland cells close to the inhalant aperture, at the point where pseudo-faeces might be expected to collect before expulsion, appear to be larger and more diffuse than those more anterior.

The anterior adductor muscle is large and elongate. The posterior adductor muscle is somewhat larger and much more rounded in cross-section. Fusion of the inner mantle folds separates both the inhalant aperture from the pedal gape and the short exhalant siphon.

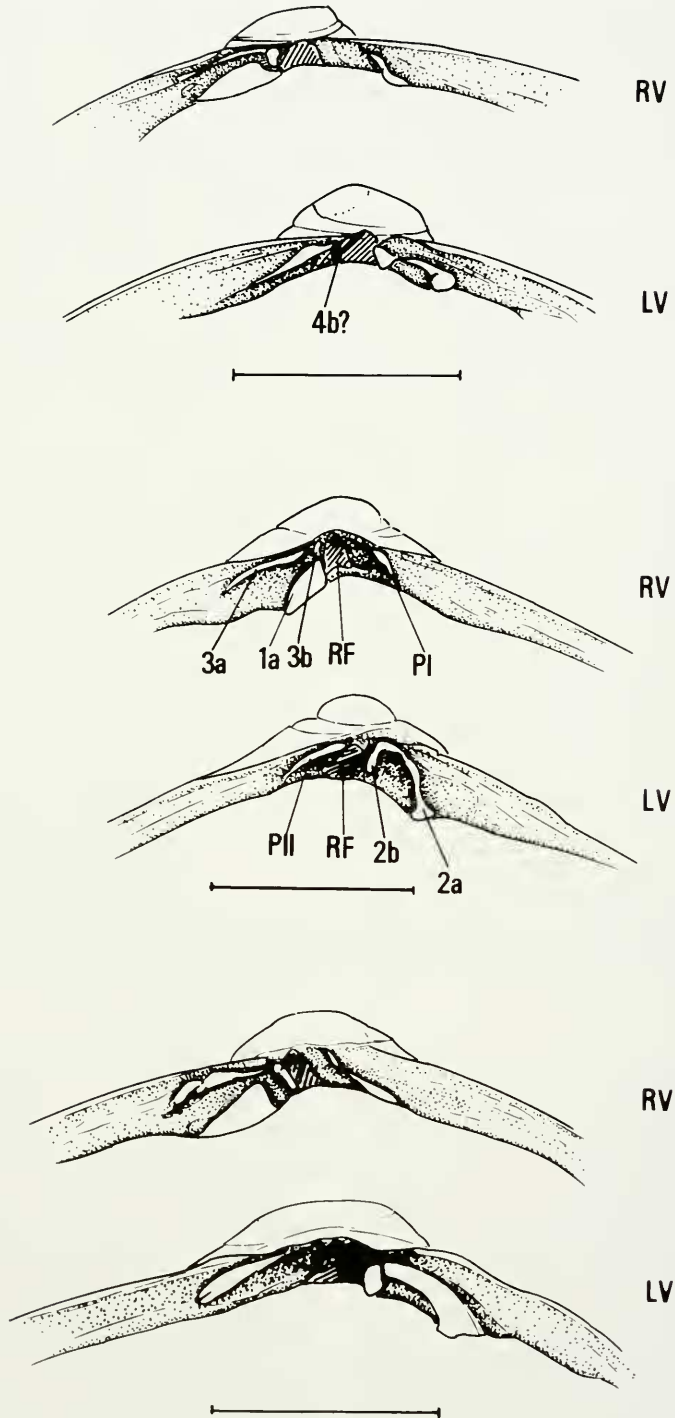


FIG. 2. Lateral views of the left and right hinge plates of three specimens from the type locality to show individual differences. For list of abbreviations, see p. 124. Scale = 0.5 mm.

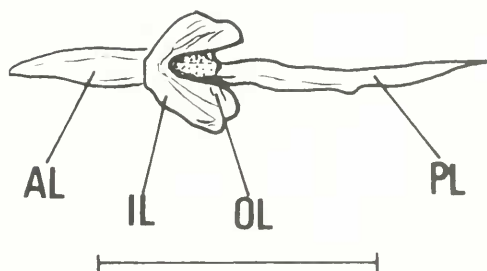


FIG. 3. Ventral view of a ligament of a specimen from the type locality. For list of abbreviations, see p. 124. Scale = 0.5 mm.

The latter in the preserved specimens lies flipped within the suprabranchial chamber. The inhalant aperture is surrounded by numerous short sensory tentacles developed from the inner of the two sensory folds. The number varies from specimen to specimen, with 9–12 on each side, and the tentacles are arranged in two rings (Fig. 5). Those of the inner ring are slightly more slender than those of the outer and tend to point inwards. The base of the exhalant apertures is surrounded by a similar number of small, circular papillae in a single ring. These papillae stain much more darkly in haematoxylin than do the inhalant tentacles.

The gills comprise both demibranchs, which have non-plicate, homorhabdic filaments. There are no interlamellar connectives and few interfilamentar connectives. The latter are present at the free margins, and in the case of the inner demibranch there are two or three rows of interfilamentar connectives between margin and axis. The outer demibranch is shorter than the inner, only extending along the posterior half of the gill axis and reflected dorsally to cover the kidney and heart.

The foot is a broad blade, laterally compressed and with a well-defined heel. No byssus was observed. The palps are small (Fig. 6). The anterior (dorsal) are finger-like processes at the outer limits of the lips, each with three internal ridges. The posterior (ventral) palps form small, semicircular, lateral pads and also have three internal ridges. The gut is simple. The oesophagus opens into a relatively voluminous stomach. The style sac and midgut are combined. The hind gut passes posterior to the stomach to the mid-dorsal margin, where it turns posteriorly to pass through the ventricle of the heart and

dorsal to the kidney and posterior adductor muscle to the anus. Digestive diverticula lie, for the most part, lateral and anterior to the stomach.

The sexes are separate. The gonads lie posterior to the stomach. A mature female approximately 2.5 mm total length had 12–14 large eggs. The largest eggs measured 200  $\mu\text{m}$  longest dimension. No brooding larvae were observed within the mantle cavity.

*Neolepton profundorum* most closely resembles *N. antipodum* in shell and body morphology, but differing in shell outline, with *N. profundorum* being the slightly more elongate and with the concentric sculpture very much less obvious (Ponder, 1969). *Neolepton profundorum* possesses a protoconch with a clearly marked, smooth marginal rim, similar to that described by Salas & Gofas (1998). It also possesses a lunule defined by a fine line that is reminiscent of the kelliellids.

## DISCUSSION

Although the concentric ridging is much less marked, the shell of *N. profundorum*, including the prodissoconch with its smooth marginal rim, is similar to that of other species described by Ponder (1969) and Salas & Gofas (1998). This also applies to the body morphology. Judging by the size of the foot *N. profundorum*, like *N. antipodum*, can be highly mobile. The latter species can fix itself to the substratum by mucus and extend the mantle margins somewhat beyond the shell margins (Ponder, 1969). Whether *N. profundorum* has the same habit is unknown, but from the similarity in morphology, it might be expected. Both species have extensive mucus glands in the mantle internal to the inner mantle folds. While other functions have been suggested, for example, Soot-Ryen (1960) found eggs adhering to the glandular epithelium, Ponder (1968) thought that they, like other bivalve mantle glands, were associated with the transport of particles and the formation of pseudofaeces. It is likely that this is the case for the posterior gland cells in *N. profundorum*; unfortunately, there is no evidence from the present samples to say whether the anterior mantle glands are associated with egg brooding. *Neolepton antipodum* occurs, mucus bound, among the thalli of coralline algae and also in soft sediments, where it lies partially buried at the surface ei-

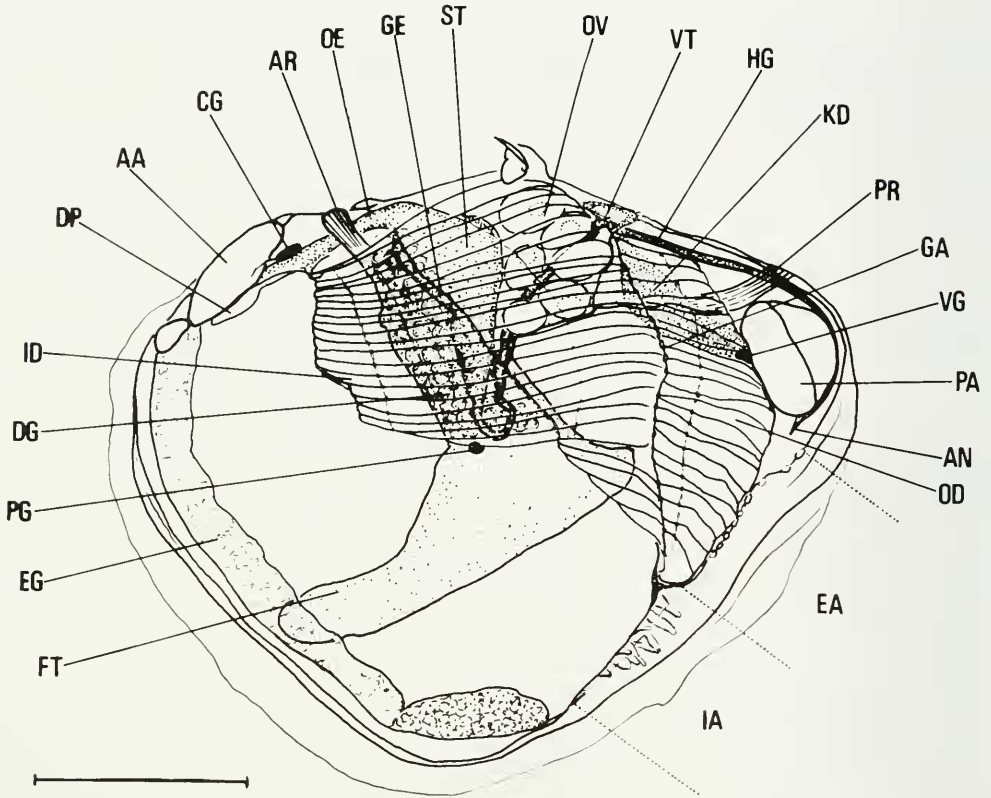


FIG. 4. Lateral semidiagrammatic view of the internal anatomy from the left side of a specimen from the type locality with the shell removed. For list of abbreviations, see p. 124. Scale = 0.5mm.

ther obliquely upside down or vertically (Ponder, 1969). Again, it seems likely that *N. profundorum* may have the same habit in soft sediment.

Although they belong to separate superfamilies (Cyamioidea and Glossoidea), the shell and internal morphology of *N. abyssorum* shares similarities with species of the family Kelliellidae. These include the form of the gill and palps, and the structure of the posterior apertures and their associated sensory papillae. In addition, the general shape of the shell and the form of the lunule could well be mistaken for that of a kelliellid. Points of major difference include the hinge teeth and ligament and the form of the foot. The similarities are likely to be a matter of convergence, with *Kelliella* and *Neolepton* probably having similar life styles.

Salas & Gofas (1998) debated the relation-

ship of the neoleptonids with the Veneridae and came to the conclusion that there were similarities between the hinge teeth and the internal anatomies of the two. The significance of these is debateable. Salas & Gofas (1998) pointed out that differences in the hinge include the lack of cardinal 4b and posterior lateral teeth in *Neolepton* as compared with venerids. To these differences must be added the great differences in the size of the palps and the fact that the outer demibranchs of the gill in the venerids is not reflected. These latter might well be a reflection of difference in size of the adults. In the case of the hinge of some specimens of *N. profundorum*, there is what appears to be a tiny cardinal 4b situated close to the margin of the resilium, and in some of the photographs in the paper by Salas & Gofas (1998) (e.g., *N. cancellatum*, p. 46, fig. 28), there is an indication of a



FIG. 5. Diagram of the arrangement of tentacles around the inhalant and exhalant apertures.

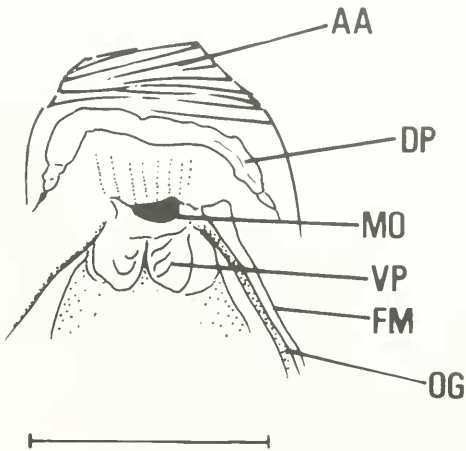


FIG. 6. Internal view of the region of the mouth of a specimen from the type locality. For list of abbreviations, see p. 124. Scale = 0.5 mm.

similar structure. It is possible that the occurrence of cardinal (4b) and the well-developed posterior lateral tooth of the venerids is but a reflection of the structural need of the stouter shell, and as such *Neolepton* may well be a paedomorphic veneracean as Salas & Gofas (1998) suggest.

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